KAPITEL 2 / *CHAPTER 2* [2]
PROSPECTS OF BIM IN UKRAINE

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Introduction

The introduction of BIM technologies in the world is taking place at a growing pace, and often with state support [1, 2, 4]. In Ukraine, there is also a revival of interest in information modeling of building systems, but this process is inherent only to individual integrated enterprises or companies with foreign investments. BIM is actively used in the construction industry of Ukraine, where its effectiveness is obvious: the construction of large shopping and entertainment centers (for example, Ocean Plaza, Respublika in Kyiv, etc., Fig. 1), multifunctional objects with complex internal infrastructure (for example, the shelter over the Chornobyl nuclear power plant).

Figure 1 - BIM model and facade of the largest in Ukraine shopping center "Respublika" in Kyiv (arch. bureau "Archimatika", 2014)

At the same time, the main barriers which postpone active steps to the introduction of BIM in Ukraine are:

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- the high cost of BIM software complexes compared to the cost of project services;

- profitability only for large, typical, or foreign projects;

- unsettled regulatory framework regarding the status of information modeling and its implementation in the construction process at all stages;

- imperfect legislation that allows the production of structures by unqualified participants;

- the uncertainty of the distribution of responsibility and intellectual property rights;

- the unwillingness of investors to additionally invest in information models that can be used not only during construction but also during the operation of facilities;

- inertia and traditionality of the construction industry, insufficient understanding of the advantages of BIM;

- compatibility between different software products, development of uniform data transfer standards;

- the inertia of the construction industry regarding the implementation of BIM, the unpreparedness of design executors; the asymmetry of risks and rewards in construction; lack of standardized business and contract models in construction, to which the end-to-end BIM process could be tied.

At the same time, it is possible to notice that the key factors that perform stimulating of the introduction of BIM-technologies in Ukraine economy in modern conditions:

- orientation of the design to external Western markets, for which BIM-approach is natural;

- implementation of European construction standards, which are organic for BIM complexes;

- the increase in the cost of energy carriers, which forces developers and owners to switch to information technologies for design, construction, and operation with a high level of forecasting and control;

- implementation of energy-saving programs and reforms, which encourages the state to act as an effective energy-saving owner;

- expectations of foreign investments and programs and the need for effective control over their implementation.

2.1. Mechanism of BIM introduction

Organically constructively oriented BIMs were first all used in the field of designing steel structures, which have an end-to-end integrated chain of design, production, and installation. Historically, the design of steel structures in Ukraine and the CIS consists of two sections: MS (metal structures) and DMS (detailed metal structures) [3, 5, 6, 7]. BIM technology allows you to model objects of any complexity, without dividing the process into CM and CMD.

Complete information models of buildings take longer to create than ordinary drawings of MS and DMS, but allow you to get all the design documentation for the object. The high geometric accuracy of constructions, obtained with the help of BIM, and the ability to transfer data to CAM systems (to production equipment) significantly increase the manufacturability of production and reduce installation time, as well as make it possible to implement complex architectural forms, minimize project development terms, and making changes to it [8].

In order to popularize BIM technology and its approach in Ukraine, at the beginning of 2014, the Ukrainian Steel Construction Center concluded a partnership agreement with the Tekla company, which specializes in the development of very complex architectural, engineering, and construction software.

Thus, as part of the signed agreement, the parties agreed to jointly promote one-stage design and a complex approach of BIM modeling on the Ukrainian market in order to significantly improve the entire efficiency of steel construction. Further promising steps for the development of BIM approach in Ukraine should be as follows:

- modern standards should contain a description and establish the status of the information model;
- implementation of BIM implementation at the state level, special programs for normative adaptation of BIM complexes, and development of own specialized software;
- launch of pilot projects for the development of information models of typical objects and digitization of existing buildings and systems;
- the opening of the geo-information BIM database of cities, which is also an element of sustainable development of the urban environment and electronic democracy.

Experience shows that the transition of companies to BIM requires gradual changes that take place according to the concept (first of all, the implementation of

small, typical objects) in a separate part of the staff (the so-called BIM team). Such an approach, under the condition of homogeneity and gradualness of work performance, can lead to an increase in productivity over time.

A total transition to BIM is inevitable in the future. But it should be understood that it is possible only under the condition of changing technologies and organization of the design process [9]. For the active use of BIM technologies in Ukraine, it is necessary, first of all, to conduct explanatory work, and to change the approach of customers and designers of construction objects, while the effective customer should be the state.

Also, it is very important to introduce the legal environment regarding its relevance in modern world and modern economy together with widely used standards of the construction industry, especially in areas of challenged requirements to preparation of project and its documentation, conflict between requirements of the State Technical Service of Ukraine/DSTU, and accepted ISO DSTU, etc. Taking into account, all facts mentioned above, there is a proposal to review the following state norms and standards (Table 1).

Table 1 – International fundamental standards that must be adopted in Ukraine during first phase of the BIM implementation

ISO #	ISO Full Title
ISO 2006-2	Building construction – Organization of information about construction works – Part 2: Framework for classification
ISO 12006-3	Building construction – Organization of information about construction works – Part 3: Framework for object-oriented information
ISO/TS 12911	Framework for building information modelling (BIM) guidance
ISO 16354	Guidelines for knowledge libraries and object libraries
ISO 16739-1	Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries – Part 1: Data schema
ISO 16757-1	Data structures for electronic product catalogues for building services – Part 1: Concepts, architecture and model
ISO 16757-2	Data structures for electronic product catalogues for building services – Part 2: Geometry
ISO 19650-1	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 1: Concepts and principles

ISO #	ISO Full Title
ISO 19650-2	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 2: Delivery phase of the assets
ISO 19650-3	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 3: Operational phase of assets
ISO 19650-4	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 4: Information exchange
ISO 19650-5	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 5: Specification for security-minded building information modelling, digital built environments and smart asset management
ISO 22263	Organization of information about construction works – Framework for management of project information

2.2. BIM's methods advantage

BIM goes beyond design and is inseparably used for the production, operation, and diagnostics of buildings, serves as an information cluster filled with information on the interaction between building systems, models of their degradation in real conditions, data on ergonomics, ecology during operation and disposal - this is how the Digital City is formed [7, 9,10]. In this case, the sources of filling are automated monitoring systems with stationary sensors receiving information in real-time, as well as people who are the end users of the building and have sensors in mobile devices. Inevitable integration of BIM with other global information tools, such as social networks, GPS, and data monitoring systems regarding loads and impacts on the building, and its interaction with the environment. Thus, a BIM building with all subsystems makes it possible to manage and adjust its condition as a complete object, to accumulate qualitative and quantitative data that form a knowledge base for decision-making for subsequent buildings [6].

The detailed information model of the building allows you to optimize its

parameters, reveals sensitivity to changes in conditions and parameters, and exposes all their interdependencies. During the construction and operation of the building, the information model in real-time accumulates the history of the occurrence of deviations in the states of the system elements and their elimination. The use of intellectualized work performance tools and integration with augmented reality systems minimizes the difference between virtual and actual models, allows timely detection of unplanned situations, and offers ways to respond [5]. Accumulated invaluable experience can be used for planning maintenance and repair programs, and drawing up degradation models of system elements both for a specific building and for analogs. BIM allows us to shape the economy of sustainable development, record, and create the history of our civilization [8, 9].

It is necessary to revise the following legal framework regarding its relevance and relevance in modern conditions of the construction industry, especially in moments of outdated requirements to preparation of project documentation, conflict with existing requirements of the State Technical Service of Ukraine/DSTU, and accepted ISO DSTU, etc. Currently, there is a proposal to review the following state norms and standards (Table 2).

Table 2 – ISO standards that must be adopted during second phase of the BIM implementation

ISO #	ISO Full Title
ISO 29481-1	Building information models – Information delivery manual – Part 1: Interaction framework
ISO 29481-2	Building information models – Information delivery manual – Part 2: Interaction framework
ISO/DIS 21597-1	Information container for data drop – Exchange specification – Part 1: Container
ISO/DIS 21597-1	Information container for data drop – Exchange specification – Part 2: Dynamic semantics
ISO 22263	Organization of information about construction works – Framework for management of project information
ISO 19650-3	Organization of information about construction works – Information management using building information modelling – Part 3: Operational phase of assets
ISO 19650-4	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling — Part 4: Information exchange

ISO #	ISO Full Title
ISO 19650-5	Organization of information about construction works – Information management using building information modelling – Part 5: Specification for security-minded building information modelling, digital built environments and smart asset anagement
ISO/DIS 21597-1	Information container for data drop – Exchange specification – Part 1: Container
ISO/DIS 21597-2	Information container for data drop – Exchange specification – Part 2: Container
ISO/DIS 23386	Building information modelling and other digital processes used in construction – Methodology to describe, author and maintain properties in interconnected dictionaries
ISO/CD 23387	Product data templates, for products and systems used in construction works, stored in a data dictionary framework – Part 1: General concepts, relations, and general structure of product data templates, and how to link the product data templates to Industry Foundation Classes (IFC)
ISO 15686-1	Building Construction – Service Life Planning – Part 1: General principles and framework
ISO 15686-2	Building Construction – Service Life Planning – Part 2: Service life prediction procedures
ISO 15686-3	Building Construction – Service Life Planning – Part 3: Performance audits and reviews
ISO 15686-4	Building Construction – Service Life Planning – Part 4: Service Life Planning using Building Information Modelling
ISO 15686-5	Building Construction – Service Life Planning – Part 5: Life-cycle costing
ISO 15686-6	Building Construction – Service Life Planning – Part 6: Procedures for considering environmental impacts
ISO 15686-7	Building Construction – Service Life Planning – Part 7: Performance evaluation for feedback of service life

On the other hand, for the full implementation of BIM, it is necessary to develop certain technical manuals, regulations, and protocols regarding the principles and requirements of modeling, data exchange, etc., based on the best international practices.In order to speed up the process, it is possible to adopt the "cover method" of part of the normative documents that require priority implementation.

Conclusions

It should be noted that the number of strategic documents of Ukraine is much smaller than the number of documents of the European Union, which does not give an opportunity to see the general strategic aspirations of the state in all spheres. There are no direct mentions of BIM technologies in the available documents, but their implementation contributes to the achievement of many tasks set by state bodies and specified in various documents.